Badger Meter Europa GmbH

ModMAG® M2000
ModBus® memory map

USER MANUAL

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1. Overview

ModMAG® M2000 supports ModBus® RTU communications. Port A (pins 5,6,7) support ModBus® RTU using RS232.The RS485 is supported as an accessory daughterboard. This daughterboard is supplied under Badger Meter p/n 67079-003.
The tables to follow identify the ModBus® registers and attributes that exist in the ModMAG® M2000 flow meter. Each register has attributes that are also specified in the tables.

1.1 Write security

Write security identifies the required security level of the register in order to be successfully written. This attribute does not apply to the readability of the register and registers listed with admin, service or user are unprotected if the meter is not secured (that is, admin pin is not programmed.)

- Firmware - Typically, read-only registers.This means only the flow meter firmware has the privilege to update the register.
- Factory – Includes registers that can only be written by the factory
- Admin – Registers that require admin level access
- Service – Registers that require service level access
- User – Registers that require user level access
- None – Register is always unprotected

All registers can be protected by enabling security on the flow meter. Once the flow meter is secured, all registers are write-protected unless remote privilege is granted. All read accesses to registers are still accepted when the flow meter is secured.

Obtaining remote privilege for write operations requires a sequence of modbus actions to take place. Remote login process is encrypted to ensure protection of the log-in pins.

- Read the random value register (address 0x012B).
- Perform necessary calculations (contact Badger Meter for details).
- Write the remote login register (address 0x012F).

It is advised that a support application is written to perform this process and embedded within the main application software used to access the flow meter.

1.2 Register name

When applicable, describes the parameter so it can be associated within the display menu items. Please note, not all registers are directly modifiable via the menu manager. Also, some registers are not accessible via the menu manager.

1.3 Register address

Register address defines the physical address that is required to be transmitted over the ModBus® RTU serial link. Some third-party applications require the use of logical addressing when communicating over ModBus®. The logical address determines the ModBus® function code that is transmitted over the serial link.

Two logical address ranges are supported, 3xxxx and 4xxxx. Logical address range 3xxxx issues the read input register function code 0x04. Logical address range 4xxxx issues the read holding register function code 0x03. All logical addresses start at index 1 (example, 30001 and 40001).

For example, suppose the application requires logical addressing and is targeting to access the “Flow rate [User units]” register. The physical address for this register is 0xF1 or 241d. This register can be read from two different logical addresses (30242 or 40242). The logical address is calculated by adding the physical address to the logical start address (30001 or 40001).

- 30001 + 241 = 30242 (Issues function code 0x04 – Read Input Register)
- 40001 + 241 = 40242 (Issues function code 0x03 – Read Holding Register)

1.4 Register type

Register type identifies the number of registers the parameter requires. Each register is 16 bits. Supported register types include:

Register type	Description	Number of ModBus® registers
UCHAR16	Unsigned character (16 bits)	1
UCHAR16[x]	Unsigned character Array	X
UINT16	Unsigned integer (16 bits)	1
SINT16	Signed integer (16 bits)	1
UINT32	Unsigned integer (32 bits)	2
FLOAT32	Floating point (32 bits)	2

For FLOAT32 register types, these registers make use of IEEE-754 floating point standard. For example, 1.0 is transmitted as 0x3F800000. ModBus® serial link will transmit the most significant byte first, 0x3F, followed by 0x80, 0x00, 0x00.

1.5 Read / Write

The Read/Write attribute identifies if the parameter is read-only or writeable. Parameters that are read only are specified as such, otherwise, the parameter can be considered accessible with write commands.

1.6 FNC support

FNC support identifies the ModBus® function codes (commands) available to access the register. Supported ModBus® function codes include:

ModBus® function code	Description
0x03	Read holding register
0x04	Read input register
0x06	Preset single register (write)
0x10	Preset multiple registers (write multiple)

Important:

Write function codes are not accepted while menu navigation is in process.
Write function codes update only the working register located in volatile memory. Any sequence of writes must be followed by a write of value 0x01 to the “Command Action Request Register”, address 0x0125. Otherwise changes will be lost if the flow meter is power cycled or reset.
For efficiency, it is possible with read function codes, 0x03 and 0x04, to read blocks of registers.This allows for the ability to read multiple registers in one transmission.

2. Memory maps by category

2.1 Product identification

No.	Write security	Register name	Register address	Register Type	Read / Write	FNC support
1	Firmware	Product code	0x0000	UINT16	Read only	0x03, 0x04
2	Firmware	Product name	0x0001	UCHAR16[8]	Read only	0x03, 0x04
3	Firmware	Firmware name	0x0009	UCHAR16[16]	Read only	0x03, 0x04
4	Factory	Application Version	0x0019	UCHAR16[10]	--	0x03, 0x04, 0x06, 0x10
5	Firmware	Compile date [MM:DD:YYYY]	0x0023	UCHAR16[16]	Read only	0x03, 0x04
6	Firmware	Compline time [HH:MM:SS]	0x0033	UCHAR16[16]	Read only	0x03, 0x04
7	Factory	PCB serial number	0x0043	UCHAR16[5]	--	0x03, 0x04, 0x10
8	Firmware	OTP boot checksum	0x0048	UCHAR16[3]	Read only	0x03, 0x04
9	Firmware	Flash OS checksum	0x004B	UCHAR16[3]	Read only	0x03, 0x04
10	Firmware	Boot version	0x004E	UCHAR16[5]	Read only	0x03, 0x04
11	Firmware	OS version	0x0053	UCHAR16[4]	Read only	0x03, 0x04
12	None	Daughterboard product type	0x0057	UINT16	Port B	0x03, 0x04, 0x06, 0x10
13	None	Daughterboard major version	0x0058	UINT16	Port B	0x03, 0x04, 0x06, 0x10
14	None	Daughterboard minor verion	0x0059	UINT16	Port B	0x03, 0x04, 0x06, 0x10
15	Factory	Power on splash line 1	0x005A	UCHAR16[11]	--	0x03, 0x04, 0x06, 0x10
16	Factory	Poser on splash line 2	0x0156	UCHAR16[11]	--	0x03, 0x04, 0x06, 0x10
17	None	Meter tag name	0x0161	UCHAR16[17]	--	0x03, 0x04, 0x06, 0x10

2.2 Meter calibration

No.	Write security	Register name	Register address	Register Type	Read / Write	FNC support
18	Admin	Detector diameter	0x006F	UINT16	--	0x03, 0x04, 0x06, 0x10
19	Admin	Detector diameter Other [mm]	0x0070	UINT16	--	0x03, 0x04, 0x06, 0x10
20	Admin	Detector factor	0x0071	FLOAT32	--	0x03, 0x04, 0x10
21	Firmware	[Factory] Detector factor	0x0073	FLOAT32	Read only	0x03, 0x04
22	Admin	Detector offset [m/s]	0x0075	FLOAT32	--	0x03, 0x04, 0x10
23	Firmware	[Factory] Detector offset	0x0077	FLOAT32	Read only	0x03, 0x04
24	Admin	Amplifier factor	0x0079	FLOAT32	--	0x03, 0x04, 0x10
25	Firmware	[Factory] Amplifier factor	0x007B	FLOAT32	Read only	0x03, 0x04
26	Admin	Detector current [mA]	0x007D	FLOAT32	--	0x03, 0x04, 0x10
27	Firmware	[Factory] Detector current [mA]	0x007F	FLOAT32	Read only	0x03, 0x04
28	Service	Power line frequency [Hz]	0x0081	UINT16	--	0x03, 0x04, 0x06, 0x10
29	Admin	Excitation frequency [Hz]	0x0082	UINT16	--	0x03, 0x04, 0x06, 0x10
30	Service	Scale factor [%]	0x010B	FLOAT32	--	0x03, 0x04, 0x10

2.3 Meter measurement settings

No.	Write security	Register name	Register address	Register Type	Read / Write	FNC support
31	User	Flow unit	0x0083	UINT16	--	0x03, 0x04, 0x06, 0x10
32	User	Volume unit	0x0084	UINT16	--	0x03, 0x04, 0x06, 0x10
33	User	Unit multiplier	0x0085	UINT16	--	0x03, 0x04, 0x06, 0x10
34	User	Zero scale flow [User units]	0x010D	FLOAT32	--	0x03, 0x04, 0x10
35	User	Full scale velocity [m/s]	0x0086	FLOAT32	--	0x03, 0x04, 0x10
36	User	Full scale flow [User units]	0x0090	FLOAT32	--	0x03, 0x04, 0x10
37	User	Low flow cutoff [%]	0x008E	FLOAT32	--	0x03, 0x04, 0x10
38	User	Flow direction	0x0092	UINT16	--	0x03, 0x04, 0x06, 0x10
39	User	Damping factor [s]	0x0093	UINT16	--	0x03, 0x04, 0x06, 0x10

2.4 Digital input

No.	Write security	Register name	Register address	Register Type	Read / Write	FNC support
40	Service	Digital input: Input operation	0x0094	UINT16	--	0x03, 0x04, 0x06, 0x10
41	Firmware	Digital input: Status	0x0155	UINT16	Read only	0x03; 0x04

2.5 Analog output

No.	Write security	Register name	Register address	Register Type	Read / Write	FNC support
42	Service	Analog output range	0x0095	UINT16	--	0x03, 0x04, 0x06, 0x10
43	Firmware	Analog output offset	0x0096	FLOAT32	Read only	0x03; 0x04
44	Admin	Analog output calibration point A [A]	0x0126	FLOAT32	--	0x03, 0x04, 0x10
45	Admin	Analog output calibration point B [A]	0x0128	FLOAT32	--	0x03, 0x04, 0x10
46	Firmware	[FACTORY] Analog output: Calibration point A [A]	0x0088	FLOAT32	Read only	0x03; 0x04
47	Firmware	[FACTORY] Analog output: Calibration point B [A]	0x008C	FLOAT32	Read only	0x03; 0x04
48	Firmware	Analog output slope	0x0131	FLOAT32	Read only	0x03; 0x04
49	Service	Analog customer offset 4 mA [A]	0x0133	FLOAT32	--	0x03, 0x04, 0x10
50	Service	Analog customer offset 20 mA [A]	0x0135	FLOAT32	--	0x03, 0x04, 0x10
51	Firmware	Analog output current [A]	0x014E	FLOAT32	Read only	0x03; 0x04
52	Firmware	Analog output current string [mA]	0x0150	FLOAT32	Read only	0x03; 0x04
53	Service	Alarm mode	0x012E	UINT16		0x03, 0x04, 0x06, 0x10
54	None	Fixed current mode	0x008A	FLOAT32	Port B	0x03, 0x04, 0x10

2.6 Output #1

No.	Write security	Register name	Register address	Register Type	Read / Write	FNC support
55	Service	Output #1: Pulses per unit [m^3]	0x0098	FLOAT32	--	0x03, 0x04, 0x10
56	Service	Output #1: Pulses per unit [User units]	0x009C	FLOAT32	--	0x03, 0x04, 0x10
57	Service	Output #1: Pulses width [ms]	0x00A0	UINT16	--	0x03, 0x04, 0x06, 0x10
58	Service	Output #1: Flow alarm minimum [%]	0x00A1	UINT16	--	0x03, 0x04, 0x06, 0x10
59	Service	Output #1: Flow alarm maximum [%]	0x00A2	UINT16	--	0x03, 0x04, 0x06, 0x10
60	Service	Output #1: Output mode	0x00A3	UINT16	--	0x03, 0x04, 0x06, 0x10
61	Service	Output #1: Ouput operation	0x00A4	UINT16	--	0x03, 0x04, 0x06, 0x10

2.7 Output #2

No.	Write security	Register name	Register address	Register Type	Read / Write	FNC support
62	Service	Output #2: Pulses per unit [m^3]	0x00A5	FLOAT32	--	0x03, 0x04, 0x10
63	Service	Output #2: Pulses per unit [User units]	0x00A9	FLOAT32	--	0x03, 0x04, 0x10
64	Service	Output #2: Pulses width [ms]	0x00AD	UINT16	--	0x03, 0x04, 0x06, 0x10
65	Service	Output #2: Flow alarm minimum [%]	0x00AE	UINT16	--	0x03, 0x04, 0x06, 0x10
66	Service	Output #2: Flow alarm maximum [%]	0x00AF	UINT16	--	0x03, 0x04, 0x06, 0x10
67	Service	Output #2: Output mode	0x00B0	UINT16	--	0x03, 0x04, 0x06, 0x10
68	Service	Output #2: Ouput operation	0x00B1	UINT16	--	0x03, 0x04, 0x06, 0x10

2.8 Output #3

No.	Write security	Register name	Register address	Register Type	Read / Write	FNC support
69	Service	Output #3: Full scale frequency [Hz]	0x00B2	UINT16	--	0x03, 0x04, 0x06, 0x10
70	Service	Output #3: Flow alarm minimum [%]	0x00B3	UINT16	--	0x03, 0x04, 0x06, 0x10
71	Service	Output #3: Flow alarm maximum [%]	0x00B4	UINT16	--	0x03, 0x04, 0x06, 0x10
72	Service	Output #3: Output mode	0x00B5	UINT16	--	0x03, 0x04, 0x06, 0x10
73	Service	Output #3: Hardware select	0x00B6	UINT16	--	0x03, 0x04, 0x06, 0x10
74	Service	Output #3: Output operation	0x00B7	UINT16	--	0x03, 0x04, 0x06, 0x10

2.9 Output #4

No.	Write security	Register name	Register address	Register Type	Read / Write	FNC support
75	Service	Output #4: Flow alarm minimum [%]	0x00B8	UINT16	--	0x03, 0x04, 0x06, 0x10
76	Service	Output #4: Flow alarm maximum [%]	0x00B9	UINT16	--	0x03, 0x04, 0x06, 0x10
77	Service	Output #4: Output mode	0x00BA	UINT16	--	0x03, 0x04, 0x06, 0x10
78	Service	Output #4: Hardware select	0x00BB	UINT16	--	0x03, 0x04, 0x06, 0x10
79	Service	Output #4: Output operation	0x00BC	UINT16	--	0x03, 0x04, 0x06, 0x10

2.10 Port A diagnostic counters

No.	Write security	Register name	Register address	Register Type	Read / Write	FNC support
80	Firmware	Port A: Packets processed	0x00BD	UINT16	Read only	0x03, 0x04
81	Firmware	Port A: Bradcast packets	0x00BE	UINT16	Read only	0x03, 0x04
82	Firmware	Port A: CRC errors	0x00BF	UINT16	Read only	0x03, 0x04
83	Firmware	Port A: Packets received	0x00C0	UINT16	Read only	0x03, 0x04
84	Firmware	Port A: Packets sent	0x00C1	UINT16	Read only	0x03, 0x04
85	Firmware	Port A: Parity errors	0x00C2	UINT16	Read only	0x03, 0x04
86	Firmware	Port A: Framing errors	0x00C3	UINT16	Read only	0x03, 0x04
87	Firmware	Port A: Overrun errors	0x00C4	UINT16	Read only	0x03, 0x04
88	Firmware	Port A: Break detects	0x00C5	UINT16	Read only	0x03, 0x04

2.11 Port B diagnostic counters

No.	Write security	Register name	Register address	Register Type	Read / Write	FNC support
90	Firmware	Port B: Packets processed	0x00C6	UINT16	Read only	0x03, 0x04
90	Firmware	Port B: Bradcast packets	0x00C7	UINT16	Read only	0x03, 0x04
91	Firmware	Port B: CRC errors	0x00C8	UINT16	Read only	0x03, 0x04
92	Firmware	Port B: Packets received	0x00C9	UINT16	Read only	0x03, 0x04
93	Firmware	Port B: Packets sent	0x00CA	UINT16	Read only	0x03, 0x04
94	Firmware	Port B: Parity errors	0x00CB	UINT16	Read only	0x03, 0x04
95	Firmware	Port B: Framing errors	0x00CC	UINT16	Read only	0x03, 0x04
96	Firmware	Port B: Overrun errors	0x00CD	UINT16	Read only	0x03, 0x04
97	Firmware	Port B: Break detects	0x00CE	UINT16	Read only	0x03, 0x04

2.12 Measurements

No.	Write security	Register name	Register address	Register Type	Read / Write	FNC support
98	Firmware	T1/T+[m^3]	0x00CF	FLOAT32	Read only	0x03, 0x04
99	Firmware	T1/T+ [User units]	0x00D3	FLOAT32	Read only	0x03, 0x04
100	Firmware	T1/T+ Display string	0x0137	UCHAR16[8]	Read only	0x03, 0x04
101	Firmware	T2/T- [m^3]	0x00D7	FLOAT32	Read only	0x03, 0x04
102	Firmware	T2/T- [User units]	0x00DB	FLOAT32	Read only	0x03, 0x04
103	Firmware	T2/T- Display string	0x013F	UCHAR16[8]	Read only	0x03, 0x04
104	Firmware	T3/TN [m^3]	0x00DF	FLOAT32	Read only	0x03, 0x04
105	Firmware	T3/TN [User units]	0x00E3	FLOAT32	Read only	0x03, 0x04
106	Firmware	T3/TN Display string	0x0147	UCHAR16[8]	Read only	0x03, 0x04
107	Firmware	T1/T+ Rollover counter	0x00E7	UINT16	Read only	0x03, 0x04
108	Firmware	T2/T- Rollover counter	0x00E8	UINT16	Read only	0x03, 0x04
109	Firmware	Flow velocity [m/s]	0x00E9	FLOAT32	Read only	0x03, 0x04
110	Firmware	Flow rate [m^3/s]	0x00ED	FLOAT32	Read only	0x03, 0x04
111	Firmware	Flow rate [User units]	0x00F1	FLOAT32	Read only	0x03, 0x04
112	Firmware	Relative flow rate [%]	0x00F3	FLOAT32	Read only	0x03, 0x04
113	Firmware	Preset batch totalizer [m^3]	0x00EB	FLOAT32	Read only	0x03, 0x04
114	Firmware	Preset batch totalizer [User units]	0x00EF	FLOAT32	Read only	0x03, 0x04
115	Firmware	Flow direction	0x012D	UINT16	Read only	0x03, 0x04

2.13 Meter diagnostic counters

No.	Write security	Register name	Register address	Register Type	Read / Write	FNC support
116	Firmware	Power up counter	0x00F5	UINT16	Read only	0x03, 0x04
117	Firmware	Detector error counter	0x00F6	UINT16	Read only	0x03, 0x04
118	Firmware	Empty pipe counter	0x00F7	UINT16	Read only	0x03, 0x04
119	Firmware	Full scale counter	0x00F8	UINT16	Read only	0x03, 0x04
120	Firmware	Totalizer overflow counter	0x00F9	UINT16	Read only	0x03, 0x04
121	--	Reserved	0x00FA	UINT16	Read only	0x03, 0x04
122	--	Reserved	0x00FB	UINT16	Read only	0x03, 0x04
123	Firmware	Pulse sync counter	0x00FC	UINT16	Read only	0x03, 0x04
124	Firmware	ADC Interrupt counter	0x00FD	UINT16	Read only	0x03, 0x04
125	Firmware	ADC range counter	0x00FE	UINT16	Read only	0x03, 0x04
126	Firmware	WDT resets counter	0x00FF	UINT16	Read only	0x03, 0x04
127	Firmware	WDT location	0x0100	UINT16	Read only	0x03, 0x04
128	Firmware	System error #	0x0101	UINT16	Read only	0x03, 0x04
129	Firmware	Token error counter	0x0102	UINT16	Read only	0x03, 0x04
130	--	Reserved	0x0103	UINT16	Read only	0x03, 0x04
131	--	Reserved	0x0104	UINT16	Read only	0x03, 0x04
132	--	Reserved	0x0105	UINT16	Read only	0x03, 0x04
133	Firmware	Meter status	0x0106	UINT16	Read only	0x03, 0x04
134	Firmware	Action request overflows	0x0109	UINT16	Read only	0x03, 0x04
135	Firmware	Measurement overflows	0x010A	UINT16	Read only	0x03, 0x04
136	Firmware	Remote resets	0x0154	UINT16	Read only	0x03, 0x04

2.14 Miscellaneaous

No.	Write security	Register name	Register address	Register Type	Read / Write	FNC support
137	Firmware	Power loss totalizer [seconds]	0x0107	UINT16	--	0x03, 0x04
138	User	Display backlights mode	0x010F	UINT16	--	0x03, 0x04, 0x06, 0x10
139	Service	Preset batch amount [m^3]	0x0110	FLOAT32	--	0x03, 0x04
140	Admin	Menu reset allowed	0x0112	UINT16	--	0x03, 0x04, 0x06, 0x10
141	User	Menu language setting	0x0114	UINT16	--	0x03, 0x04, 0x06, 0x10
142	User	File System - Number of records to read	0x0117	UINT16	--	0x03, 0x04, 0x06, 0x10
143	None	Configuration status	0x011D	UINT16	Port B	0x03, 0x04, 0x06, 0x10
144	None	Port B extended address	0x0118	UINT16	Port B	0x03, 0x04, 0x06, 0x10

2.15 Verification tool support

No.	Write security	Register name	Register address	Register Type	Read / Write	FNC support
145	Firmware	Analog input measure value	0x0115	FLOAT32	Read only	0x03, 0x04
146	Admin	Analog input measure counter	0x0119	UINT16	--	0x03, 0x04, 0x06, 0x10
147	Firmware	Empty pipe actual Resistance [ohms]	0x011A	FLOAT32	Read only	0x03, 0x04

2.16 Empty pipe

No.	Write security	Register name	Register address	Register Type	Read / Write	FNC support
148	Admin	Empty pipe calibration [volts]	0x011E	FLOAT32	--	0x03, 0x04, 0x10
149	Firmware	Empty pipe measure value [volts]	0x0120	FLOAT32	Read only	0x03, 0x04
150	Admin	Full pipe calibration [volts]	0x0122	FLOAT32	--	0x03, 0x04, 0x10
151	Service	Empty pipe mode	0x0124	UINT16	--	0x03, 0x04, 0x06, 0x10

2.17 Control commands

No.	Write security	Register name	Register address	Register Type	Read / Write	FNC support
152	None	Command action request	0x0125	UINT16	--	0x03, 0x04, 0x06, 0x10
153	Service	Flow simulation	0x012A	SINT16	--	0x03, 0x04, 0x06, 0x10

2.18 Security

No.	Write security	Register name	Register address	Register Type	Read / Write	FNC support
154	Firmware	Security status	0x011C	UINT16	Read only	0x03, 0x04
155	Firmware	Random value	0x012B	UINT32	Read only	0x03, 0x04
156	Firmware	Remote login	0x012F	UINT32	Read only	0x10

3. M2000 memory map by register address

Register address	Register name	Register type
0x0000	Product code	UINT16
0x0001	Product name	UCHAR16[8]
0x0009	Firmware name	UCHAR16[16]
0x0013	Reserved	UINT16
0x0019	Application Version	UCHAR16[10]
0x0023	Compile Date [MM:DD:YYYY]	UCHAR16[16]
0x0033	Compile Time [HH:MM:SS]	UCHAR16[16]
0x0043	PCB serial number	UCHAR16[5]
0x0048	OTP boot checksum	UCHAR16[3]
0x004B	Flash OS checksum	UCHAR16[3]
0x004E	Boot version	UCHAR16[5]
0x0053	OS version	UCHAR16[4]
0x0057	Daughterboard product type	UINT16
0x0058	Daughterboard major version	UINT16
0x0059	Daughterboard minor version	UINT16
0x005A	Power on splash line 1	UCHAR16[11]
0x0065	Reserved (to addr 0x006E)	UINT16[10]
0x006F	Detector diameter	UINT16
0x0070	Detector diamether other [mm]	UINT16
0x0071	Detector factor	FLOAT32
0x0073	[FACTORY] Detector factor	FLOAT32
0x0075	Detector offset [m/s]	FLOAT32
0x0077	[FACTORY] Decetor offset	FLOAT32
0x0079	Amplifier factor	FLOAT32
0x007B	[FACTORY] Amplifier factor	FLOAT32
0x007D	Detector current [m^3/s]	FLOAT32
0x007F	[FACTORY] Detector current [mA]	FLOAT32
0x0081	Power line frequency [Hz]	UINT16
0x0082	Excitation frequency [Hz]	UINT16
0x0083	Flow unit	UINT16
0x0084	Volume unit	UINT16
0x0085	Unit multiplier	UINT16
0x0086	Full scale velocity [m/s]	FLOAT32
0x0088	[FACTORY] Analog output calitbration Point A [A]	FLOAT32
0x008A	Fixed current mode	FLOAT32
0x008C	[FACTORY] Analog output calibration Point A [A]	FLOAT32
0x008E	Low flow cutoff [%]	FLOAT32
0x0090	Full scale flow [User units]	FLOAT32
0x0092	Flow direction	UINT16
0x0093	Damping factor [s]	UINT16

Register address	Register name	Register type
0x0094	Digital input: Input operation	UINT16
0x0095	Analog output range	UINT16
0x0096	Analog output offset	FLOAT32
0x0098	Output #1: Pulses per unit [m^3]	FLOAT32
0x009A	Reserved (to addr 0x09B)	UINT16 [2]
0x009C	Output #1: Pulses per unit [User unit]	FLOAT32
0x009E	Reserved (to addr 0x009F)	UINT16 [2]
0x00A0	Output #1: Pulse width [ms]	UINT16
0x00A1	Output #1: Flow alarm minimum [%]	UINT16
0x00A2	Ouput #1: Flow alarm maximum [%]	UINT16
0x00A3	Ouput #1: Output mode	UINT16
0x00A4	Ouput #1: Output operation	UINT16
0x00A5	Ouput #2: Pulses per unit [m^3]	FLOAT32
0x00A7	Reserved (to addr 0x00A8)	UINT16 [2]
0x00A9	Ouput #2: Pulses per unit [User unit]	FLOAT32
0x00AB	Reserved (to addr 0x00AC)	UINT16 [2]
0x00AD	Ouput #2: Pulse width [ms]	UINT16
0x00AE	Ouput #2: Flow alarm minimum [%]	UINT16
0x00AF	Ouput #2: Flow alarm maximum[%]	UINT16
0x00B0	Ouput #2: Ouput mode	UINT16
0x00B1	Ouput #2: Ouput operation	UINT16
0x00B2	Ouput #3: Full scale frequency [Hz]	UINT16
0x00B3	Ouput #3: Flow alarm minimum [%]	UINT16
0x00B4	Ouput #3: Flow alarm maximum[%]	UINT16
0x00B5	Ouput #3: Ouput mode	UINT16
0x00B6	Ouput #3: Hardware select	UINT16
0x00B7	Ouput #3: Output operation	UINT16
0x00B8	Ouput #4: Flow alarm minimum [%]	UINT16
0x00B9	Ouput #4: Flow alarm maximum[%]	UINT16
0x00BA	Ouput #4: Ouput mode	UINT16
0x00BB	Ouput #4: Hardware select	UINT16
0x00BC	Ouput #4: Output operation	UINT16
0x00BD	Port A: Packets processed	UINT16
0x00BE	Port A: Broadcast Packet	UINT16
0x00BF	Port A: CRC errors	UINT16
0x00C0	Port A: Packets received	UINT16
0x00C1	Port A: Packets sent	UINT16
0x00C2	Port A: Parity errors	UINT16
0x00C3	Port A: Framing errors	UINT16
0x00C4	Port A: Overrun errors	UINT16
0x00C5	Port A: Break detects	UINT16
0x00C6	Port B: Packets processed	UINT16
0x00C7	Port B: Broadcast packets	UINT16
0x00C8	Port B: CRC errors	UINT16

Register address	Register name	Register type
0x00FD	ADC interrupt counter	UINT16
0x00FE	ADC range counter	UINT16
0x00FF	WDT resets counter	UINT16
0x0100	WDT location	UINT16
0x0101	System error #	UINT16
0x0102	Reserved	UINT16
0x0103	Reserved	UINT16
0x0104	Reserved	UINT16
0x0105	Reserved	UINT16
0x0106	Meter status	UINT16
0x0107	Power loss totalizer [seconds]	UINT32
0x0109	Achtion request overflows	UINT16
0x010A	Measurement overflows	UINT16
0x010B	Scale factor [%]	FLOAT32
0x010D	Zero scale flow [user units]	FLOAT32
0x010F	Display backlight mode	UINT16
0x0110	Preset batch amount [m^3]	FLOAT32
0x0112	Menu reset allowed	UINT16
0x0114	Menu language settings	UINT16
0x0115	Analog input measure value	FLOAT32
0x0117	File system – Numer ov records to read	UINT16
0x0118	Port B extended address	UINT16
0x0119	Analog input measure counter	UINT16
0x011A	Empty pipe actual resistance [ohms]	FLOAT32
0x011C	Security status	UINT16
0x011D	Configuration status	UINT16
0x011E	Empty pipe calibration [volts]	FLOAT32
0x0120	Empty pipe measure value [volts]	FLOAT32
0x0122	Full pipe calibration [volts]	FLOAT32
0x0124	Empty pipe mode	UINT16
0x0125	Command action request	UINT16
0x0126	Analog output calibration point A [A]	FLOAT32
0x0128	Analog output calibration point B [A]	FLOAT32
0x012A	Flow simulation	SINT16
0x012B	Random value	UINT32
0x012D	Flow direction	UINT16
0x012E	Alarm mode	UINT16
0x012F	Remote login	UINT32
0x00C3	Port A: Framing errors	UINT16
0x00C4	Port A: Overrun errors	UINT16
0x00C5	Port A: Break detects	UINT16
0x00C6	Port B: Packets processed	UINT16
0x00C7	Port B: Broadcast packets	UINT16
0x00C8	Port B: CRC errors	UINT16

Register address	Register name	Register type
0x00C9	Port B: Packets received	UINT16
0x00CA	Port B: Packets sent	UINT16
0x00CB	Port B: Parity errors	UINT16
0x00CC	Port B: Framing errors	UINT16
0x00CD	Port B: Overrun errors	UINT16
0x00CE	Port B: Break detects	UINT16
0x00CF	T1 /T+ [m^3]	FLOAT32
0x00D1	Reserved (to addr 0x00D2) – FLOAT 64	UINT16 [2]
0x00D3	T1 /T+ [user units]	FLOAT32
0x00D5	Reserved (to addr 0x00D6) – FLOAT 64	UINT16 [2]
0x00D7	T2 /T- [m^3]	FLOAT32
0x00D9	Reserved (to addr 0x00DA) – FLOAT 64	UINT16 [2]
0x00DB	T2 /T- [user units]	FLOAT32
0x00DD	Reserved (to addr 0x00DE) – FLOAT 64	UINT16 [2]
0x00DF	T3 /TN [m^3]	FLOAT32
0x00E1	Reserved (to addr 0x00E2) – FLOAT 64	UINT16 [2]
0x00E3	T3 /TN [user units]	FLOAT32
0x00E5	Reserved (to addr 0x00E6) – FLOAT 64	UINT16 [2]
0x00E7	T1 /T+ Rollover counter	UINT16
0x00E8	T2 /T- Rollover counter	UINT16
0x00E9	Flow velocity [m/s]	FLOAT32
0x00EB	Preset batch totalizer [m^3]	FLOAT32
0x00ED	Flow rate [m^3/s]	FLOAT32
0x00EF	Preset batch totalizer [user units]	FLOAT32
0x00F1	Flow rate [user units]	FLOAT32
0x00F3	Relative flow rate [%]	FLOAT32
0x00F5	Power up counter	UINT16
0x00F6	Detector error counter	UINT16
0x00F7	Empty pipe counter	UINT16
0x00F8	Full scale counter	UINT16
0x00F9	Totalizer overflow counter	UINT16
0x00FA	Reserved	UINT16
0x00FB	Reserved	UINT16
0x00FC	Pulse sync counter	UINT16

Register address	Register name	Register type
0x0131	Analog output slope	FLOAT32
0x0133	Analog customer offset 4 mA [A]	FLOAT32
0x0135	Analog customer offset 20 mA[A]	FLOAT32
0x0137	T1 /T+ Display string	UCHAR16 [8]
0x013F	T2 /T- Display string	UCHAR16 [8]
0x0147	T3 /TN Display string	UCHAR16 [8]
0x014E	Analog output current [A]	FLOAT32
0x0150	Analog output current string [mA]	UCHAR16 [4]
0x0154	Remote resets	UINT16
0x0155	Digital input: Status	UINT16
0x0156	Power on splash line 2	UCHAR16 [11]
0x0161	Meter tag name	UCHAR16 [17]
0x0172	Reserved (to addr 0x01FF)	UINT16 [142]

4. M2000 register write properties

No	Register name	Register address	Min. value	Max. value	Value definition	** Req. Action request
18	Detector diameter	0x006F	0	34	0 = Other 1 = DN6 2 = DN8 3 = DN10 4 = DN15 5 = DN20 6 = DN25 7 = DN32 8 = DN40 9 = DN50 10 = DN65 11 = DN80 12 = DN100 13 = DN125 14 = DN150 15 = DN200 16 = DN250 17 = DN300 18 = DN350 19 = DN400 20 = DN450 21 = DN500 22 = DN550 23 = DN600 24 = DN700 25 = DN750 26 = DN800 27 = DN900 28 = DN1000 29 = DN1050 30 = DN1200 31 = DN1400 32 = DN1600 33 = DN1800 34 = DN2000	YES
19	Detector diameter other [mm]	0x0070	0	2032	--	YES
22	Detector offset [m/s]	0x0075	-10.00	10.00	--	YES
24	Amplifier factor	0x0079	1	9,999,999,999	--	YES
** Command action code 0x01 should be issued to the command action request register immediately following any non – volatile register uptdate**						

No	Register name	Register address	Min. value	Max. value	Value definition	** Req. Action request
26	Detector current [mA]	0x007D	100	400	--	YES
28	Power line frequency [Hz]	0x0081	0	1	0 =50 Hz 1 = 60 Hz	YES
29	Excitation frequency [Hz]	0x0082	0	3	0 = 1 Hz 1 = 3.125 Hz or 3.75 Hz 2 = 6.25 Hz or 7.5 Hz 3 = 12.5 hz or 15 Hz	YES
30	Scale factor [%]	0x010B	-10	10	--	YES
31	Flow unit	0x0083	0	18	0 = LPS 1 = LPM 2 = LPH 3 = M^3S 4 = M^3M 5 = M^3H 6 = F^3S 7 = F^3M 8 = F^3H 9 = GPS 10 = GPM 11 = GPH 12 = MGD 13 = IPS 14 = IPM 15 = IPH 16 = LBM 17 = OZM 18 = BPM	YES
32	Volume unit	0x0084	0	10	0 = Liter 1 = Hectoliters 2 = Cubic meters 3 = Cubic feet 4 = US gallons 5 = Mega gallons 6 = UK gallons 7 = Pounds 8 = Ounces 9 = Acre feet 10 = Barrels	YES
** Command action code 0x01 should be issued to the command action request register immediately following any non – volatile register uptdate**						

No	Register name	Register address	Min. value	Max. value	Value definition	** Req. Action request
33	Unit multiplier	0x0085	0	32771	0 = Off 1 = 1 unit 10 = 10 units 100 = 100 units 1000 = 1000 units 10000 = 10000 units 32768 = 0.1 units 32769 = 0.01 units 32770 = 0.001 units 32771 = 0.0001 units	YES
34	Zero scale flow [user units]	0x010D	0	10 % of full scale	--	YES
35	Full scale velocity [m/s]	0x0086	0	12	--	YES
36	Full scale flow [user units]	0x0090	0	Variable	--	YES
37	Low flow cutoff [%]	0x008E	0	9.9	--	YES
38	Flow direction	0x0092	0	1	0 = uni-directional 1 = bi-directional	YES
39	Damping factor [s]	0x0093	0	30	0 = 0 second 1 = 1 second 2 = 2 seconds 3 = 3 seconds 4 = 4 seconds 5 = 5 seconds 10 = 10 seconds 20 = 20 seconds 30 = 30 seconds	YES
40	Digital input: Input operation	0x0094	0	3	0 = Off 1 = Remote reset 2 = Positive zero return 3 = Batch reset	YES
42	Analog output range	0x0095	1	4	1 = 4…20 mA 2 = 0…20 mA 3 = 0…20 mA 4 = 2…20 mA	YES
** Command action code 0x01 should be issued to the command action request register immediately following any non – volatile register uptdate**						

No	Register name	Register address	Min. value	Max. value	Value definition	** Req. Action request
44	Analog output calibration point A [A]	0x0126	0	0.024	--	YES
45	Analog output calibration point B [A]	0x0128	0	0.024	--	YES
49	Analog customer offset 4 mA [A]	0x0133	0	0.024	--	YES
50	Analog customer offset 20 mA [A]		0	0.024		YES
53	Alarme mode	0x012E	0	2	0: Meter error has no influence on analog output 1: Meter error drives output 2 mA below minimum range 2: Meter error drives output 2 mA above maximum range	YES
54	Fixed current mode	0x008A	0	20	--	YES
55	Output #1: Pulses per unit [m^3]	0x0098	0	9999999.999	--	YES
56	Output #1: Pulses per unit [user unit]	0x009C	0	9999999.999	--	YES
57	Output #1: Pulse width [ms]	0x00A0	0	9999	0 = 50 % duty cycle	YES
58	Output #1: Flow alarm minimum [%]	0x00A1	0	100	1 = 1% 100 = 100%	YES
59	Output #1: Flow alarm maximum [%]	0x00A2	0	100	1 = 1% 100 = 100%	YES
60	Output #1: Output mode	0x00A3	0	1	0 = Normally open 1 = Normally closed	YES
** Command action code 0x01 should be issued to the command action request register immediately following any non – volatile register uptdate**						

No	Register name	Register address	Min. value	Max. value	Value definition	** Req. Action request
61	Output #1: Output operation	0x00A4	0	11	0 = Off 1 = Flow alarm 2 = Empty pipe alarm 3 = Error alarm 4 = Forward pulse 5 = AMR pulse 6 = Reverse pulse 7 = Frequency output 8 = Preset batch output 9 = Flow direction 10 = Verification test 11 = 24V DC supply	
62	Output #2: Pulses per unit [m^3]	0x00A5	0	9999999.999	--	YES
63	Output #2: Pulses per unit [user unit]	0x00A9	0	9999999.999	--	YES
64	Output #2: Pulse width [ms]	0x00AD	0	9999	0 = 50 % duty cycle	YES
65	Output #2: Flow alarm minimum [%]	0x00AE	0	100	1 = 1% 100 = 100%	YES
66	Output #2: Flow alarm maximum [%]	0x00AF	0	100	1 = 1% 100 = 100%	YES
67	Output #2: Output mode	0x00B0	0	1	0 = Normally open 1 = Normally closed	YES
68	Output #2: Output operation	0x00B1	0	11	0 = Off 1 = Flow alarm 2 = Empty pipe alarm 3 = Error alarm 4 = Forward pulse 5 = AMR pulse 6 = Reverse pulse 7 = Frequency output 8 = Preset batch output 9 = Flow direction 10 = Verification test 11 = 24V DC supply	YES
** Command action code 0x01 should be issued to the command action request register immediately following any non – volatile register uptdate**						

No	Register name	Register address	Min. value	Max. value	Value definition	** Req. Action request
69	Output #3: Full scale frequency [Hz]	0x00B2	0	10000	--	
70	Output #3: Flow alarm minimum [%]	0x00B3	0	100	1 = 1% 100 = 100%	YES
71	Output #3: Flow alarm maximum [%]	0x00B4	0	100	1 = 1% 100 = 100%	YES
72	Output #3: Output mode	0x00B5	0	1	0 = Normally open 1 = Normally closed	YES
73	Output #3: Hardware select	0x00B6	0	1	0 = Relay 1 = Open collector	YES
74	Output #3: Output operation	0x00B7	0	11	0 = Off 1 = Flow alarm 2 = Empty pipe alarm 3 = Error alarm 4 = Forward pulse 5 = AMR pulse 6 = Reverse pulse 7 = Frequency output 8 = Preset batch output 9 = Flow direction 10 = Verification test 11 = 24V DC supply	YES
** Command action code 0x01 should be issued to the command action request register immediately following any non – volatile register uptdate**						

No	Register name	Register address	Min. value	Max. value	Value definition	** Req. Action request
75	Output #4: Flow alarm minimum [%]	0x00B8	0	100	1 = 1% 100 = 100%	
76	Output #4: Flow alarm maximum [%]	0x00B9	0	100	1 = 1% 100 = 100%	YES
77	Output #4: Output mode	0x00BA	0	1	0 = Normally open 1 = Normally closed	YES
78	Output #4: Hardware select	0x00BB	0	1	0 = Relay 1 = Open collector	YES
79	Output #4: Output operation	0x00BC	0	11	0 = Off 1 = Flow alarm 2 = Empty pipe alarm 3 = Error alarm 4 = Forward pulse 5 = AMR pulse 6 = Reverse pulse 7 = Frequency output 8 = Preset batch output 9 = Flow direction 10 = Verification test 11 = 24V DC supply	YES
138	Display backlight mode	0x010F	0	2	0 = Forced on 1 = Forced off 0 = Timed off	YES
139	Preset batch amount [m^3]	0x0110	0	295735.295	295735.295 m^3 = 9,999,999,999 Oz	YES
140	Menu reset allowed	0x0112	0	1	1 = All totalizers are resetable 0 = otherwise	YES
141	Menu language settings	0x0114	0	1	0 = English 1 = Alternate	YES
142	File system – Number of records to read	0x0117	0	10000	# of records to extract from memory token	NO
146	Analog input measurement counter	0x0119	0	0	--	NO
148	Empty pipe calibration [volts]	0x011E	0	3	--	YES
150	Full pipe calibration [volts]	0x0122	0	3	--	YES
** Command action code 0x01 should be issued to the command action request register immediately following any non – volatile register uptdate**						

No	Register name	Register address	Min. value	Max. value	Value definition	** Req. Action request
151	Empty pipe mode	0x0124	0	5	0 = Off 1 = On 2-5 = Reserved	YES
152	Command action request	0x0125	0	0	0 = No action 1 = Save RAM to EEPROM 2 = Load EEPROM to RAM 3 - 5 = Reserved 6 = Save totalizers to EEPROM 7 = Clear T1 or T+ 8 = Clear T2 or T- 9 = Clear TN 10 = Clear all totalizer 11 = Clear port A diagnostics 12 = Clear port B diagnostics 13 = Clear all error counts 14 - 20 = Reserved 21 = Clear power off totalizer 22 = Reserved 23 = Remote reset 24 = Restore factory Calibration data 25 = Reserved 26 = Reserved 27 = Reset batch amount 28 = Remote logoff 29 = Save RAM to EEPROM (port B only)	YES
153	Flow simulation	0x012A	-100	100	0xFF80 = Disable	NO

** Command action code 0x01 should be issued to the command action request register immediately following any non – volatile register uptdate**

5. Troubleshooting

ModBus® transmissions can be rejected for various reasons:

- Write request received while menu navigation is in process.
- Write request received with an invalid value (out-of range value).
- Write request received to a secured meter.
- Invalid register address supplied in modbus serial request.
- Invalid number of registers supplied in modbus serial request (too many or too few).
- Invalid function code supplied in ModBus® serial request.
- The following error response codes are returned.

Error response code	Reason
0x01 – Illegal function code	Request received with invalid function code
0x02 – Illegal data address	Write request received with invalid number of registers
	Write request received with address not supported
	Write request received to a read only register
0x03 – Illegal data Value	Read request received with invalid number of register
	Write/Read request received has too many registers to read
	Write request received with invalid value
0x04 – Device failure	Write request reived to a protected parameter (secured device, menu navigation in progress).

ModBus® transmissions may not be responded to for various reasons:

- Bad CRC – Verify serial link is properly shielded.
- Framing / Parity errors – Verify serial communication settings match for both the flow meter and application software.
- Wrong port address – Verify the flow meter is properly programmed with the correct node address.
- Duplicate port addresses on serial link – May cause collisions when multiple meters respond at the same time.
- Wrong serial wiring – verify wiring is appropriate.
- For RS485, lack of termination on end devices or lack of biasing by ModBus® Master. Flow meter does not provide RS485 biasing. This is assumed to be accomplished by the ModBus® Master.

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